

Name: \_\_\_\_\_

Due Date: \_\_\_\_\_

Key

HONORS CHEM: SOLUTIONS REVIEW PACKET

- A solution is best described as a
  - heterogeneous mixture
  - homogeneous mixture
  - compound
  - element
- A change in pressure will have the greatest influence on the solubility of a
  - solid in a liquid
  - liquid in a gas
  - gas in a liquid
  - liquid in a solid
- As temperature increases, the solubility of solid calcium chloride in water
  - increases
  - decreases
  - remains the same

colloid suspension

only affects gases

Pressure will confine the gas to get it to dissolve.

Temp ↑ solubility of a solid

- Based on the Solubility Guidelines chemistry reference table, which compound is insoluble?

TABLE F

- barium sulfate
- sodium sulfate
- potassium sulfate
- lithium sulfate

exception to SO4<sup>2-</sup> rule

- Compounds containing the chloride ion (Cl<sup>-</sup>) are insoluble when combined with

- magnesium (Mg<sup>2+</sup>)
- silver (Ag<sup>+</sup>)
- sodium (Na<sup>+</sup>)
- calcium (Ca<sup>2+</sup>)

Table F

- According to the Solubility Curves chemistry reference table, what is the maximum number of grams of NH<sub>4</sub>Cl that will dissolve in 200g of water at 70°C?

Table G

- 62 g
- 124 g
- 100 g
- 85 g

62g NH<sub>4</sub>Cl / 100g H<sub>2</sub>O

- According to the Solubility Curves chemistry reference table, the solubility of which compound decreases most rapidly as the temperature changes from 10°C to 70°C?

Table G

- KCl 30g → 48g
- NH<sub>4</sub>Cl 34g → 62g
- HCl 77g → 52g
- NH<sub>3</sub> 70g → 18g

CHECK EACH ONE!!

These are gases

- Which solution contains the greatest number of moles of solute?

- 2 L of a 2 M solution
- 0.5 L of a 2 M solution
- 0.5 L of a 0.5 M solution - .25 mol
- 2 L of a 0.5 M solution - 1 mol

M = mol / L

\* M x L = # moles

- How many grams of KOH are needed to prepare 250 mL of a 2.00 M solution of KOH? (gram formula mass = 56.0 g/mol)

Convert to L

- 112 g
- 2.00 g
- 1.00 g
- 28.0 g

M = mol / L

2.00 M = x mol / .250 L

.5 mol KOH (56.0 g / 1 mol) = 28g

x = .5 mol

$$\text{ppm} = \frac{\text{mass solute}}{\text{mass solution}} \times 10^6$$

10. How many grams of KI are needed to prepare 2,000 g of an aqueous solution containing 25 parts per million (ppm) of solute?

- a.  $5.0 \times 10^4$  g  
b. 0.0125 g

- c. 0.050 g  
d.  $1.25 \times 10^4$  g

$$\frac{25 \text{ ppm}}{10^6} = \frac{x}{2000 \text{ g solution}} \quad x = .05$$

11. A solution is made by dissolving an electrolyte in water. The solution conducts electricity as a result of the presence of

- a. atoms  
b. ions

- c. molecules  
d. compounds

freely moving charged particle

12. Which solution has the highest boiling point?

- a. 1 mole of  $\text{NaNO}_3$  in 750 g of water  
b. 1 mole of  $\text{NaNO}_3$  in 1000 g of water  
c. 1 mole of  $\text{NaNO}_3$  in 250 g of water  
d. 1 mole of  $\text{NaNO}_3$  in 500 g of water

most amount of dissolved solute.

\* ↑ solute or ↓ solvent

same solute

lowest solvent

13. What factors determine the degree of solubility of a substance in a solution?

Solids ~ ↑ temp ↑ solubility

Gases ~ ↑ temp ↓ solubility  
↑ pressure ↑ solubility

how much solute dissolves.  
nature of solute + solvent influences both solids + gases

14. Identify three ways to increase the rate of solution for:

Solid solutes ~ crush solute  
inc. temp of solvent  
stir

Gaseous solutes ~ ↑ pressure  
↓ temp of solvent  
do not agitate

how fast it dissolves

15. Explain the saying "like dissolves like" and its relevance to solution formation.

Substances with similar polarities will easily create a solution.

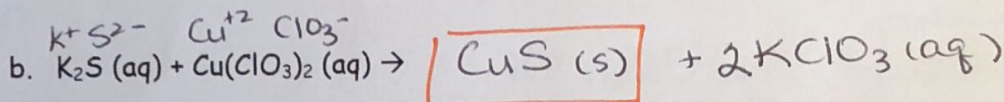
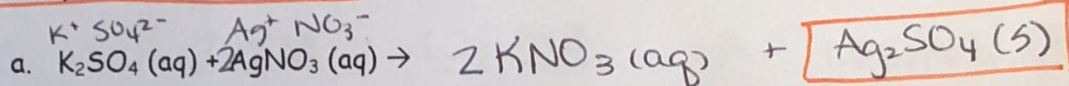
# Table F

16. Identify if each of the following ionic substances is soluble or insoluble in water.

- a.  $\text{Na}_2\text{CO}_3$  soluble
- b.  $\text{CaSO}_4$  insoluble
- c. ammonium nitrate soluble
- d. copper (II) bromide soluble  
 $\rightarrow \text{CuBr}_2$

17. Determine the products for each of the following double replacement reactions.

Identify the insoluble product (if any).



18. Identify the substance that creates a saturated solution under the listed conditions. *on the line Table G*

a. 5 g solute in 100 g solvent at 50°C  $\text{SO}_2$

b. 140 g solute in 200 g solvent at 23°C HCl

c. 55 g solute in 50 g solvent at 45°C  $\text{NaNO}_3$

$\frac{70\text{g}}{100\text{g}} @ 23^\circ$

$\frac{110\text{g}}{100\text{g H}_2\text{O}} @ 45^\circ$

19. Identify if each of the following represents an unsaturated, saturated or supersaturated solution. *\* determine amount to be saturated*

*above line*

a. 45 g KCl in 100g  $\text{H}_2\text{O}$  at 60°C saturated

b. 70 g KI in 50 g  $\text{H}_2\text{O}$  at 10°C supersaturated

c. 80 g NaCl in 200 g  $\text{H}_2\text{O}$  at 90°C saturated

$\frac{140\text{g KI}}{100\text{g H}_2\text{O}} @ 10^\circ$

$\frac{40\text{g NaCl}}{100\text{g H}_2\text{O}} @ 90^\circ$

*under line*

*on line Table G*

$\rightarrow$  to be saturated 45g/100g  $\text{H}_2\text{O}$

136g/100g  $\text{H}_2\text{O}$

40g/100g  $\text{H}_2\text{O}$

20. If 100 g of KI is dissolved in 100 g water at 20°C, how much more KI must be added to saturate the solution at that temperature?

@ 20°C 145g KI will saturate 100g  $\text{H}_2\text{O}$

$145\text{g} - 100\text{g} = \boxed{45\text{g needed}}$

21. A saturated solution of  $\text{KNO}_3$  is cooled from 60°C to 50°C, how much  $\text{KNO}_3$  precipitated from the solution?

saturated @ 60°C 107g

saturated @ 50°C 84g

$\frac{23\text{g}}{23\text{g}}$  will settle out.

22. Determine the molarity of a solution that contains 47.8 g Na<sub>2</sub>CO<sub>3</sub> dissolved in water to make a 7.5 L solution. g → mol

$$M = \frac{\text{mol solute}}{\text{L solution}}$$

$$\begin{array}{r} \text{Na } 2(22.99) = 45.98 \\ \text{C } 1(12.01) = 12.01 \\ \text{O } 3(16.00) = 48.00 \\ \hline 105.99 \text{ g/mol} \end{array}$$

$$47.8 \text{ g Na}_2\text{CO}_3 \left( \frac{1 \text{ mol}}{105.99 \text{ g}} \right) =$$

$$.450986 \text{ mol}$$

$$M = \frac{.450986 \text{ mol}}{7.5 \text{ L}} = .06013$$

$$.060 \text{ M Na}_2\text{CO}_3$$

23. What volume is needed to make a 2.0 M solution of Li<sub>2</sub>SO<sub>3</sub> if 1.25 moles of solute is used? mol/L

$$M = \frac{\text{mol solute}}{\text{L solution}}$$

$$2.0 \text{ M} = \frac{1.25 \text{ mol}}{x \text{ L}} \quad \text{OR} \quad 1.25 \text{ mol} \left( \frac{1 \text{ L}}{2.0 \text{ mol}} \right)$$

$$x = .625 \text{ L} = .63 \text{ L}$$

24. What is the percent mass of a solution that contains 28 g KBr in 250 g of water?

$$\% = \frac{\text{mass solute}}{\text{mass solution}} \times 100$$

\* need to find total solution } solute + solvent = solution  
28g + 250g = 278g solution

$$\frac{28 \text{ g KBr}}{278 \text{ g solution}} \times 100 = 10.1\% \text{ KBr}$$

25. A 13 g sample of water contains  $4.5 \times 10^{-4}$  g of fluoride ions. What is the concentration of fluoride ions in parts per million?

$$\text{ppm} = \frac{\text{mass solute}}{\text{mass solution}} \times 10^6$$

$$\frac{4.5 \times 10^{-4} \text{ g fluoride}}{13 \text{ g solution}} \times 10^6 = 34.61538$$

$$35 \text{ ppm fluoride}$$

26. What mass of NaOH is dissolved in 560 g of a 22% NaOH solution?

$$\% = \frac{\text{mass solute}}{\text{mass solution}} \times 100$$

$$\frac{22}{100} = \frac{x}{560 \text{ g}} \quad x = 123.2$$

$$120 \text{ g NaOH}$$

$$\text{Pb } 1(207.2) = 207.2$$

$$\text{N } 2(14.01) = 28.02$$

$$\text{O } 6(16.00) = 96.00 \quad / \quad 331.22 \text{ g/mol}$$

27. How many grams of  $\text{Pb}(\text{NO}_3)_2$  are needed to make 500.0 mL of a 0.25 M solution? Molarity

Step 1: Convert mL into Liters  $500.0 \text{ mL} \left( \frac{1 \text{ L}}{1000 \text{ mL}} \right) = 0.5000 \text{ L}$

$$M = \frac{\text{mol Pb}(\text{NO}_3)_2}{\text{L solution}}$$

Step 2: Determine # moles in the solution.

$$0.25 \text{ M} = \frac{x \text{ mol}}{0.5000 \text{ L}} \quad x = 0.125 \text{ mol Pb}(\text{NO}_3)_2$$

Step 3: Determine # grams (mol  $\rightarrow$  g)

\* see last page for alternative setup.

$$0.125 \text{ mol Pb}(\text{NO}_3)_2 \left( \frac{331.22 \text{ g}}{1 \text{ mol}} \right) = 41.4025 \text{ g} \quad \boxed{41 \text{ g}}$$

28. What is the percent by volume of a solution that contains 45.0 mL of acetone dissolved in 75.0 mL of cyclohexane?

solvent solute

$$\% = \frac{\text{volume solute}}{\text{volume solution}} \times 100$$

① Determine total volume of solution  
 $75.0 + 45.0 = 120.0 \text{ mL}$

② Determine %

$$\% = \frac{45.0 \text{ mL acetone}}{120.0 \text{ mL solution}} \times 100 = \boxed{37.5\%}$$

29. What is the concentration of a solution in parts per million if the solution is 1.15% solute by mass? percent = parts per 100.

$$\text{ppm} = \frac{\text{mass solute}}{\text{mass solution}} \times 10^6$$

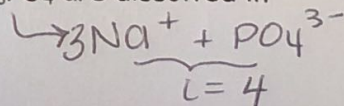
$$\frac{1.15}{100} = \frac{x}{10^6}$$

$$\boxed{x = 11500 \text{ ppm}}$$

### STOP FOR PART I OF SOLUTIONS TEST

Assessment II

30. Calculate the new boiling point of a solution in which 234.5 g  $\text{Na}_3\text{PO}_4$  are dissolved in 600. g water?



① Determine molality of solution

$$\text{Na } 3(22.99) = 68.97$$

$$\text{P } 1(30.97) = 30.97$$

$$\text{O } 4(16.00) = 64.00$$

$$147.94 \text{ g/mol}$$

$$234.5 \text{ g Na}_3\text{PO}_4 \left( \frac{1 \text{ mol}}{147.94 \text{ g}} \right) = 1.5851 \text{ mol Na}_3\text{PO}_4$$

$$600. \text{ g} \left( \frac{1 \text{ kg}}{1000 \text{ g}} \right) = 0.600 \text{ kg}$$

② solve

$$\Delta T_{\text{bp}} = m(K_{\text{bp}})(i)$$

$$\Delta T_{\text{bp}} = \left( \frac{1.5851 \text{ mol}}{0.600 \text{ kg}} \right) (0.512 \text{ }^\circ\text{C/m})(4) = 5.41 \text{ }^\circ\text{C}$$

③ new bp =  $100 \text{ }^\circ\text{C} + 5.41 = \boxed{105.41 \text{ }^\circ\text{C}}$

$$\begin{aligned}
 C & 2(12.01) = 24.01 \\
 H & 6(1.01) = 6.06 \\
 O & 1(16.00) = 16.00 \\
 & \hline
 & 46.07 \text{ g/mol}
 \end{aligned}$$

Assessment II

31. Calculate the new freezing point if 78.0 g  $C_2H_5OH$ , a nonelectrolyte is dissolved in 500.0 g of benzene. (For Benzene:  $k_{fp} = 5.12^\circ\text{C}/m$  and freezing point =  $5.533^\circ\text{C}$ )  $i = 1$

$$\Delta T_{fp} = m \times K_{fp} \times i$$

$$\Delta T_{fp} = (3.38615 \text{ m})(5.12^\circ\text{C}/m)(1)$$

$$\Delta T_{fp} = 17.337^\circ\text{C}$$

$$\text{new fp} = 5.533 - 17.337 = -11.804^\circ\text{C}$$

WORK FOR molality

$$78.0 \text{ g} \left( \frac{1 \text{ mol}}{46.07 \text{ g}} \right) = 1.693076 \text{ mol}$$

$$500.0 \text{ g} \left( \frac{1 \text{ kg}}{1000 \text{ g}} \right) = .5000 \text{ kg}$$

$$\frac{1.693076 \text{ mol}}{.5000 \text{ kg}} = 3.38615$$

Assessment II

32. What is the vapor pressure of water at  $80^\circ\text{C}$  if 690. g of sucrose ( $C_{12}H_{22}O_{11}$ ) is dissolved in 126.0 g of water?

$$VP_{\text{solution}} = VP_{\text{solvent @ } 80^\circ\text{C}} (\text{mole fraction solvent})$$

$$C_{12}H_{22}O_{11} \\ 342.34 \text{ g/mol}$$

$$690. \text{ g } C_{12}H_{22}O_{11} \left( \frac{1 \text{ mol}}{342.34} \right) = 2.0155 \text{ mol sucrose}$$

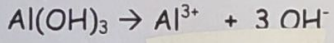
$$126.0 \text{ g } H_2O \left( \frac{1 \text{ mol}}{18.02 \text{ g}} \right) = 6.99223 \text{ mol } H_2O$$

$$VP_{\text{solution}} = 47 \text{ kPa} \left( \frac{6.99223}{9.00773} \right)$$

$$VP_{\text{solution}} = 36.5 \text{ kPa}$$

Assessment II

33. The solubility product constant for  $Al(OH)_3$  is  $1.26 \times 10^{-33}$ . What is the  $[OH^-]$  in the solution when it reaches equilibrium?



$$K_{sp} = [Al^{3+}][OH^-]^3$$

$$1.26 \times 10^{-33} = [x][3x]^3$$

$$\frac{1.26 \times 10^{-33}}{27} = \frac{27x^4}{27}$$

$$x^4 = 4.6666 \times 10^{-35}$$

$$x = 2.613676 \times 10^{-9} \text{ M}$$

$$2.61 \times 10^{-9} \text{ M}$$

$$\begin{aligned}
 [Al^{3+}] &= x \\
 [OH^-] &= 3x
 \end{aligned}
 \left. \vphantom{\begin{aligned} [Al^{3+}] &= x \\ [OH^-] &= 3x \end{aligned}} \right\} \begin{array}{l} \text{ions} \\ \text{are} \\ \text{in} \\ 1:3 \\ \text{Ratio} \end{array}$$

#27 using dimensional analysis.

$$500.0 \text{ mL} \left( \frac{1 \cancel{\text{ L}} \text{ solution}}{1000 \cancel{\text{ mL}}} \right) \left( \frac{0.25 \cancel{\text{ mol}}}{1 \cancel{\text{ L}}} \right) \left( \frac{331.22 \text{ g}}{1 \cancel{\text{ mol}}} \right) = 41.4025 \text{ g}$$

41 g  $\text{Pb}(\text{NO}_3)_2$